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(54) [Title of the Invention] Peeling Method and Peelable Laminated Composite

(57) [Abstract]

[Problem] To provide a peeling method and peelable laminated composite that allows the peelable laminated composite to be removed easily from a large surface area and allows the surface formerly covered with the peelable laminated composite to be reused without having to remove any residual adhesive.

[Solution] The peelable laminated composite has a structure consisting at the very least of an electrically conductive composition layer 4 interposed between a first and second electrode 2, 3. When the laminated composite is peeled between layers, voltage is applied between the first and second electrodes 2, 3, the electrode on the positive end is anodized, and the laminated composite is peeled at the interface between the electrode and the electrically conductive composition layer 4.

[Claims]

[Claim 1] A method for peeling a laminated composite between layers, wherein the laminated composite has a structure consisting at the very least of an electrically conductive composition layer interposed between a first and second electrode, and wherein voltage is applied between the first and second electrodes, the electrode on the positive end is anodized, and the laminated composite is peeled at the interface between the electrode and the electrically conductive composition layer when the laminated composite is peeled between layers.

[Claim 2] A peelable sheet used in the peeling method of Claim 1, wherein the peelable sheet consists of a first and second electrode, and an electrically conductive composition layer interposed between the first and second electrodes.

[Claim 3] The peelable sheet in Claim 2, wherein the first and second electrode consist of a plurality of laminated metal films.

[Claim 4] The peelable sheet in Claim 3, wherein the metal film among the plurality of laminated films at the interface with the electrically conductive composite layer has a lower standard electrode potential than the other metal films.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to a peeling method that allows the laminated composite to be peeled easily between layers when desired, and the present invention also relates to the peelable sheet used in the peeling method.

[0002]

[Prior Art] A method for easily peeling off an adhesive tape after use was disclosed in Japanese Unexamined Patent Application [Kokai] No. 3-64381. An adhesive tape consisting of an adhesive layer formed on the surface of a base material such as a

synthetic resin film is easy to apply but is difficult to remove when no longer needed. In this peeling method of the prior art, the adhesive layer formed on the surface of the thermally contracting base material contains a foaming agent.

[0003] When adhesive tape that has been applied is to be removed, it is heated. The heat shrinks the thermally contracting base and the adhesive layer containing the foaming agent begins to foam. As a result, the adhesive tape can be easily removed.

[0004]

[Problem Solved by the Invention] The adhesive tape of the prior art, in other words, can only be removed easily if heated.

[0005] Unfortunately, some of the adhesive layer also remains behind when the adhesive tape is removed. Therefore, the remaining adhesive has to be removed from the surface formerly covered by the adhesive tape before it can be reused. This makes the process more complicated. In addition, heat is required in the peeling process. If the adhesive tape to be removed has been applied to a large surface area such as a wall, it is difficult to heat the adhesive tape uniformly.

[0006] The purpose of the present invention is to provide a peeling method and peelable sheet to be used in the peeling method that allows the peelable sheet to be removed easily from a large surface area and allows the surface formerly covered by the peelable sheet to be reused without having to remove any residual adhesive.

[0007]

[Means of Solving the Problem] As a result of extensive research conducted by the present inventors to achieve this purpose, the present inventors discovered that a peelable sheet could be obtained which peels easily between layers without leaving an adhesive residue using anodization to peel off the peelable sheet at the interface between the anodized electrode and an electrically conductive composition layer in contact with the electrode. The present invention is the product of this discovery.

[0008] The first invention in this application is a method for peeling a laminated composite between layers, wherein the laminated composite has a structure consisting at the very least of an electrically conductive composition layer interposed between a first and second electrode, and wherein voltage is applied between the first and second electrodes, the electrode on the positive end is anodized, and the laminated composite is peeled at the interface between the electrode and the electrically conductive composition layer when the laminated composite is peeled between layers.

[0009] In the first invention, a laminated composite is peeled between layers and the laminated composite consists at the very least of an electrically conductive composition layer interposed between a first and second electrode. By applying voltage between the first and second electrode and anodizing the electrode on the positive end, the metal film constituting the electrode on the positive end is oxidized. As a result, the metal ions oxidized in the electrically conductive composition layer in contact with the electrode are dispersed, and the metal constituting the positive electrode is weakened or destroyed. Because the strength of the adhesive between the electrode on the positive end and the

electrically conductive composition layer is reduced, the laminated composite peels easily at the interface between the electrode on the positive end and the electrically conductive composition layer without leaving an adhesive residue.

[0010] The second invention in this application is a peelable sheet used in the peeling method of the first invention. Here, the peelable sheet consists of a first and second electrode, and an electrically conductive composition layer interposed between the first and second electrodes.

[0011] Preferably, the structure of the first and second electrodes should consist of a plurality of laminated metal films. Even more preferably, the metal film among the plurality of laminated films at the interface with the electrically conductive composite layer should have a lower standard electrode potential than the other metal films.

[0012] The following is a detailed explanation of the present invention. The first and second electrodes are made of a material that becomes electrically conductive when voltage is applied. This material is usually a metal. There are no restrictions on the type of metal used to make the first and second electrodes. In order to promote anodization, however, the metal constituting the positive electrode should be susceptible to ionization. In other words, the metal should have a low standard electrode potential. If the metal is too susceptible to ionization, the reaction will automatically promote oxidation and the bond between the electrode on the positive end and the electrically conductive composition layer will weaken over time. This reduces the reliability of the adhesive.

[0013] In the present invention, ideal examples of metals that can be used to form the electrode on the positive end include Al, Zn, Fe, Ni, Sn, Pb and Cr. The metal used to form the electrode on the positive end should be the same as the metal used to form the electrode on the negative end. This is because potential is generated between the electrodes and the metal with the lower standard electrode potential is oxidized and corroded if an electrode with a different standard electrode voltage comes into contact with the electrically conductive composition layer.

[0014] In order for the electrode and the electrically conductive composition layer to peel reliably along the interface, the area of the back of the electrode coming into contact with the electrically conductive composition layer should be greater than or equal to the area of the electrically conductive composition layer.

[0015] The structure of the laminated composite in the present invention should at the very least consist of an electrically conductive composition layer interposed between the first and second electrode. Between the first and second electrode, the peeling should occur at the interface between the electrode on the positive end and the electrically conductive composition layer. In the laminated composite of the present invention, therefore, the peelable sheet in the first invention should be interposed between base materials, and the base materials should be bonded to each other via the peelable sheet. The first and second electrodes alone can constitute the base materials to be bonded together.

[0016] Examples of laminated composites are shown in FIG 1 through FIG 4. In FIG 1, a peelable sheet 5 consisting of an electrically conductive composition material 4 between

a first and second electrode 2, 3 is interposed between laminate base materials 1, 1. In FIG 1, the outside surfaces of the first and second electrodes 2, 3 are bonded to the laminate base materials 1, 1 via adhesive layers 6, 7.

[0017] In FIG 2, support materials 8, 9 for supporting the first and second electrodes 2, 3 are laminated on the structure shown in FIG 1. In other words, the electrodes 2, 3 are formed on one side of the support materials 8, 9, and the electrodes 2, 3 supported by the support materials 8, 9 are then laminated so they face the electrically conductive composition layer 4.

[0018] In FIG 3, the laminate base materials are metal and constitute the first and second electrodes. In other words, the electrically conductive composition layer 11 is interposed between metal laminate base materials 10, 10. In the peeling method of the present invention, the laminate composite can be such that the base material laminated on both sides of the electrically conductive composition material can serve as the first and second electrodes.

[0019] In the peeling method of the present invention, voltage is applied to the first and second electrodes, the electrode on the positive end (e.g., electrode 2) is anodized, and the peelable sheet is peeled off at the interface between the electrode 2 and the electrically conductive composition layer. In the laminate composite shown in FIG 1, a direct current power source is connected between the electrodes 2, 3 as shown in FIG 4 so electrode 2 is on the positive end and electrode 2 can be anodized.

[0020] In the laminate composites of the present invention shown in FIG 1 through FIG 3, the first and second electrodes consist of metal film formed on the surface of the electrically conductive composition layer 4. Metal film can also be formed on one side of the base material. If a laminate base material made of metal is used, the laminate base material itself can serve as the first and second electrodes.

[0021] When the electrodes consist of metal film formed on one side of the base materials 8, 9 as shown in FIG 2, the structure has greater flexibility. This is even more true if the base material is made from a flexible synthetic resin film and the metal film is a metal thin film. A metal thin film can be formed on the base material using a thin film forming method such as direct deposition or sputtering. Metal foil can also be used to form the metal film.

[0022] In the peelable sheet of the present invention, the first and second electrodes can consist of a laminate of a plurality of metal films. When a plurality of metal films is laminated, the metal film formed at the interface with the electrically conductive composition should have a lower standard electrode potential than the other metal films so as to be more susceptible to ionization.

[0023] In FIG 5, electrode 2 consists of a single sheet of metal film. When anodized, some of the electrode 2 is destroyed and voltage can no longer be applied to electrode 2. In FIG 6, electrode 2 on the positive end consists of two sheets of metal film 2a, 2b formed successively on one side of the electrically conductive composition layer 4. If the standard electric potential of the metal film 2a closer to the electrically conductive composition layer 4 is lower than the standard electrode potential of the other metal film

2b, this problem can be eliminated. Even though the anodization destroys some of metal film 2a, metal film 2b remains and voltage can be applied continuously to the electrodes 2, 3.

[0024] When voltage is applied between the electrodes 2, 3, the electrically conductive composition layer should conduct electric current adequately enough to anodize one of the electrodes. A high-polymer electrolyte is ideal.

[0025] A high-polymer electrolyte naturally has adhesive force or bonding force. Therefore, the electrically conductive composition layer can be bonded directly to the first and second electrodes. High-polymer electrolytes with adhesive force or bonding force include monomers of acrylic acid, methacrylic acid, itaconic acid and sulfonic acid, polymer salts of polyamino acid, and polymer salts of these monomers. These so-called high-polymer electrolytes have a wide range of uses. These high-polymer electrolytes are not limited to these polymer salts and copolymer salts. Conductive powder (metal powder), carbon black and polyaniline can be dispersed throughout.

[0026] When the electrically conductive composition layer is formed, this method of sealing the electrically conductive composition layer does not have to be used. A more common seal forming method can be used or the electrically conductive composition layer can be applied to a base and dried.

[0027] Additives to improve the adhesive force, bonding force and conductivity can be included in the high-polymer electrolyte. The metal film can be formed directly on the surface of the electrically conductive composition layer or the first and second

electrodes consisting of metal film can be applied to the electrically conductive composition layer. Here, the natural adhesiveness of the electrically conductive composition layer can be used.

[0028] In the peeling method of the present invention, the laminated composite at the very least consists of an electrically conductive composition layer interposed between a first and second electrode. Voltage is applied between the first and second electrodes, the electrode on the positive end is anodized, and the electrode on the positive end is weakened or destroyed. As a result, the laminated composite can be peeled off easily at the interface between the electrode on the positive end and the electrically conductive composition layer. Because none of the adhesive remains behind after the peeling has been completed, the base applied to the back surface of the electrode on the positive end can be reused. Because the peeling process at the interface is easy once voltage has been applied between the first and second electrodes and the positive electrode has been anodized, the peeling process is still easy even if the first and second electrodes have a large surface area.

[0029] Because the peelable sheet of the present invention consists of a first and second electrode and an electrically conductive composition layer interposed between the first and second electrodes, the peeling method of the present invention can be used to peel off the sheet easily without any adhesive residue remaining on the base.

[0030] If the structure of the first and second electrodes consists of a plurality of laminated metal films and if the metal film at the interface with the electrically conductive composition layer has a lower standard electrode potential than the other metal films, then

the voltage can be applied continuously even as the anodization explained above is occurring.

[0031]

[Working Example] The following is a more detailed explanation of the present invention with reference to a non-restrictive working example.

[0032] (Working Example 1) The following components were weighed and used to create a high-polymer electrolyte solution.

4-Hydroxybutyl Acrylate	130.00 ppw
Acrylic Acid	70.00 ppw
Glycerin	30.00 ppw
Water	19.00 ppw
Potassium Hydroxide	19.00 ppw
Aerogel	3.00 ppw
Triethylene bis-Methacrylate	0.35 ppw
Benzylmethyl Ketal	0.35 ppw

The solution was applied to a thickness of 300 μm on a film using bar coating. A super high-voltage mercury lamp was then used to irradiate the solution with ultraviolet radiation for five minutes at 40 mW and initiate ultraviolet polymerization. The result was an electrically conductive composition layer consisting of a high-polymer electrolyte sheet.

[0033] Next, two films were prepared consisting of polyethylene terephthalate (PET) successively laminated on one side with a Cr film and a Zn film. Finally, a peelable sheet was prepared by interposing the high-polymer electrolyte sheet between the PET film with the metal film laminate on the PET film facing the inside.

[0034] In this peelable sheet, the first and second electrode consisted of laminated metal film and the electrically conductive composite layer interposed between the first and second electrodes consisted of a high-polymer electrolyte sheet. In the first and second electrode, the Cr film comes into contact with the electrically conductive composition layer.

[0035] The dimensions of the peelable sheet prepared in this manner were 10 cm x 10 cm with a thickness of 0.5 mm. The first and second electrode covered the entire electrically conductive composition layer.

[0036] A direct current voltage of 50 V was applied for one minute between the first and second electrodes of the peelable sheet. Here, the first electrode was the positive electrode. After the application of voltage, the peelable sheet was peeled off at the interface between the first electrode and the electrically conductive composition layer. The 180° peeling test was performed in accordance with Section 8.3 of JIS Z0237, and the adhesive force when peeled at 180° was measured.

[0037] The 180° peeling test was also performed before the application of the voltage. Before the voltage was applied, the result of the 180° peeling test was 2 kg/cm. After the voltage was applied, the result of the peeling test was 0.1 kg/cm.

[0038] When the first electrode was anodized, the peelable sheet was easily peeled off at the interface between the first electrode and the electrically conductive composition layer. After the application of voltage and the peeling off of the peelable sheet, the peeled surface was observed. The peeling occurred between the first electrode and the electrically conductive composition layer. No adhesive remained on the surface of the PET film on the side where the first electrode had been laminated.

[0039]

[Effect of the Invention] In the peeling method of the present invention, as explained above, a laminated composite can be peeled when desired by applying voltage between the first and second electrode, anodizing the electrode on the positive end, and peeling off the laminated composite at the interface between the electrode and the electrically conductive composition layer. It is peeled off easily when electric voltage is applied. Because heat is not required, a laminated composite with a large surface area can be peeled off easily.

[0040] Because there is no adhesive residue on the peeled surface, the peeled-off base can be reused.

[Brief Explanation of the Drawings]

[FIG 1] A cross-sectional view of a laminated composite used in the peeling method of the present invention.

[FIG 2] A cross-sectional view of another laminated composite used in the peeling method of the present invention.

[FIG 3] A cross-sectional view of yet another laminated composite used in the peeling method of the present invention.

[FIG 4] A cross-sectional view used to explain how the voltage is applied between the first and second electrodes in the laminated composite shown in FIG 1.

[FIG 5] A cross-sectional view used to explain the anodization when the first and second electrodes consist of a single metal film.

[FIG 6] A cross-sectional view used to explain the anodization when the first and second electrodes consist of a metal film laminate.

[Key to the Drawings]

- 1 ... laminate base material
- 2, 3 ... first and second electrodes
- 2a, 2b ... metal film
- 4 ... electrically conductive composition layer

5 ... peelable sheet

6, 7 ... adhesive layer

8, 9 ... support material

10, 10 ... composite of the first and second electrodes

11 ... electrically conductive composition layer

[FIG 1]

[FIG 2]

[FIG 3]

[FIG 4]

[FIG 5]

[FIG 6]